ANALYSIS OF PROTON PERSONA SIDE DOOR (DRIVER) USING SIMULATION TOOL

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JUDUL: <u>ANALYSIS OF PROTON PERSONA SIDE DOOR (DRIVER) USING SIMULATION TOOL</u>

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ANALYSIS OF PROTON PERSONA SIDE DOOR (DRIVER) USING SIMULATION TOOL

RAJA ASHRAFUZZAIM BIN RAJA ZOLKIPLY

A report submitted in partial fulfillment
of the requirements for the award
of the degree of
Bachelor Of Mechanical Engineering

Faculty of Mechanical Engineering
University Malaysia Pahang

NOVEMBER 2008

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering

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STUDENT,S DECLARATION

I declare that this entitle "*Analysis Of Proton persona Side Door (Driver) Using Simulation Tool.*" is the result of my own research expect as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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My beloved father, Mr. Raja Zolkiply Bin Raja Abdul Rahman

My loving mother Mrs. Esah Binti K.Moidu

My supervisor , Mr. Gan Leong Ming

Brothers and sister

All my friends

May Allah bless all of you

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ABSTRACT

Automobile safety is the avoidance of automobile accidents or the minimization of harmful effects of accidents, in particular as pertaining to human life and health. Numerous safety features have been built into cars for years. Safety is divided into two categories, active and passive. Active Safety is systems that use an understanding of the state of the vehicle to both avoid and minimize the effects of a crash. These include braking systems, like brake assist, traction control systems and electronic stability control systems to help the driver control the vehicle. Meanwhile, passive safety refers to built-in features of a vehicle that help reduce the effects of an accident, such as crumple zones, seatbelts, strong body structures and airbags . Impact test is conduct in 5 different ways such as side, front, pole rollover and offset. During side collision, physical event is a complicated transfer of momentum from striking car to struck car. This project consists of two steps. First is. to develop solid model by using 3D scanner and convert into simulation environment. Second is to do simulation which consists of setting the boundary condition for restraint, force and then meshing the model. The final result leads to finding that Proton Persona needs stiffer structure as unit body or by increase the numbers of impact bars. From simulation the numbers of impact bars differentiate the stress, strain and displacement result and the value clearly shown in chapter four. All result decreasing as numbers of bars added. The impact bars, outer panel and inner panel, is not enough to absorb the force applied .More on bars will reduce the stress, strain and displacement of the door.

ABSTRAK

Keselamatan pada sesebuah kenderaan adalah untuk mengelakkan kemalangan ataupun meminimakan kesan berbahaya akibat kemalangan yang menjurus kepada nyawa manusia dan kesihatan. Pelbagai ciri keselamatan telah dibina ke atas kenderaan dari masa ke semasa. Keselamatan terbahagi kepada dua iaitu aktif dan pasif. Keselamatan aktif menerangkan sistem yang digunakan untuk memahami keadaan kenderaan dimana pengelakkan dan meminimakan kesan pada pelanggaran. Ini merangkumi sistem hentian, contohnya hentian bantuan, sistem kawalan traktif dan sistem kawalan elektronik stabil,yang menganalisa signal dari pelbagai sensor untuk membantu pemandu mengawal kenderaan. Manakala, keselamatan pasif merujuk pada ciri-ciri binaan dalaman yang membantu mengurangkan kesan kemalangan seperti zon remuk, talipingang keselamatan, binaan badan yang teguh dan juga beg udara. Ujian dilakukan dalam lima bentuk cara iaitu impak dari sisi, hadapan, impak dengan tiang, golekan berulang dan impak sebelah bahagian. Ketika pelangggaran sisi, acara fizikal yang berlaku adalah peralihan momentum yang rumit dari kenderaan melanggar kepada kenderaan yang menanti. Projek ini merangkumi dua langkah utama.Pertamanya adalah untuk menghasilkan model menggunakan pengimbas tiga dimensi(3-D) dan menukarkan ke bentuk simulasi. Langkah kedua adalah untuk menjalankan simulasi yang merangkumi penetapan keadaan sempadan untuk kawalan,daya yang dikenakan dan penjaringan ke atas model.Keputusan akhir menjurus kepada penghasilan dimana Proton Persona memerlukan struktur yang lebih kuat sebagai sebuah unit badan lengkap dengan menambah bilangan palang impak.Dari simulasi,bilangan impak bar membezakan keputusan tegangan , regangan dan perubahan jarak boeh didapati dalam bab 4.Keputusan adalah menurun dengan penambahan palang. Semua struktur tidak mencukupi untukmenyerap daya diberikan.lebih banyak palang akan mengurangkan tegangan , regangan dan perubahan jarak pada pintu

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CHAPTER 1

INTRODUCTION

1.1 GENERAL OVERVIEW

1.1.1 History of Safety

The first motor cars began running in the 1880s, with primitive brakes, steering and tires, and with plate glass used for a windscreen. The potential for crashes and resulting injury was high. One of the earliest crashes resulting in fatal injury was recorded in a London newspaper in 1889 .The wooden spokes of the rear wheels fractured at the hub. All of the occupants were ejected, and the driver and a rear-seat occupant were killed [1]

The first barrier test was run by General Motors at the Milford Proving Ground in Michigan in 1934. At this time little was known of the cause of injury, and improvements in design were probably related more to reducing damage to vehicles than to reducing the risk of injury.

Automotive crash injury research was initiated by De Haven at Cornell University Medical College in New York in 1953[1] These studies identified the major sources of occupant injury as steering assembly, instrument panel, windshield and occupant ejection.

1.1.2 Improvement of Safety

In 1969, Holden established the first safety test laboratory in Australia, at the Lang Lang Proving Ground, and since that time has spent about $200M in testing, facilities and equipment to establish a world class safety test facility. General Motors has a long record of contributions to automobile safety, including such advances as safety glass, padded instrument panels, energy-absorbing steering columns [2] and infant seats. In 1977, GM developed the Hybrid III frontal test dummy, which has become the industry standard, and is universally used to evaluate the performance of restraint systems. The restraint system includes seat belts, airbag and seats. The system characteristics to be optimized include seat belt webbing stiffness, buckle pretension and webbing clamp characteristics, airbag deployment time, inflation rate, inflation pressure, airbag vent size, tether length, unfolding pattern, seat shape and stiffness, and anti-submarine ramp shape.

The first was a front structure developed to manage crash energy more efficiently, and to tailor the crash pulse to reduce loads on occupants. Following these leading front crash protection developments, in 1998 Holden was the first Australian maker to introduce side impact airbags. These side impact airbags were developed specifically to provide head and neck protection.

There are hundreds of other safety features, designs and devices that are helping preserve lives. Safety features such as energy absorbing front and side structures, air bags, seats with integrated seat belts, and various crash avoidance devices.

These are just some of the safety features offered as standard equipment on many vehicles. Future safety devices may include “smart” safety devices that would protect occupants based on age, gender, location in the vehicle, and crash severity.

The focus on vehicle safety, meaning structural crashworthiness and reduction in occupant fatalities and harm, will undoubtedly continue to sharpen during the next decades in response to consumer demands, increasing government regulation and globalization of the industry.

1.2 PROBLEM STATEMENT

Safety is always become major requirement or key part of today vehicle to minimize of harmful effect of accident especially from side impact. These forms of accident have a very significant of likelihood of fatality as cars don't have significant crumple zones to absorb the impact force before an occupant injured. From 1994 to 1997 there were 7676 fatalities per year for side impact accident estimated by National highway Traffic Safety Administration (NHTSA) [3]

Impact can be categorized from front, rear and side of car. Side impacts, especially lateral, comprise one of the most aggressive impact environment because of close proximity of occupant to the side structure which is small and occupant has very little protection from the striking vehicle [4]

Since 1985, Perusahaan Automobil Nasional (Proton) has produced several of models from Saga, Wira, Putra, Perdana, Waja and many more. The latest model is to launch is Proton Persona, upgraded from Gen-2 model as sedan model on 15 August 2007. [2]Since the first model until before Waja model there is no crash test were done. Since Malaysia regulation on crashworthiness not implement until now, all consumers are expose into danger level.

Proton Persona for Malaysian market also not meet the regulation either by NHTSA,or Euro NCAP.Many of lack in safety .Refer to figure 1.1**,**for base line ,there is no air bags at all and drum brake at rear with no antilock brake system (ABS).This will totally reduce the safety of the car. Even for the high line model, refer to figure 1.2, only front of driver and passenger airbags are installed as packages. Supposedly cars today must include all four side airbags as basic requirement with antilock brake system disc brake all wheel.

This is the problem when the accident occurs. The structure of door cannot overcome the impact from collision. Even though there is two impact bars installed in this model as in figure 1.3, it is not enough for the crashworthiness during accident. A side impact bars located inside of a vehicle door to improve the occupant's safety in the event of collision.

This project will deal with crashworthiness of driver side door of Proton Persona. Crashworthiness is the ability of the structure to absorb energy or impact and prevent occupant from severe injuries and fatality during the event of an accident. By doing the simulation, improvement can be done to the crashworthiness of the door. It implies four basic principles:

i. Limit impact focus on occupants to tolerate levels.
ii. Provide a means to manage the energy of collision, with adequate survival space for occupants.
iii. Contain occupants in survival space during collision or minimize ejection.
iv. Protect occupants from post crash hazard.

1.3 Objective

Objectives of the project are:

i. To modeling three dimensions (3-D) of door using 3-D scanner.
ii. To analysis driver side door stress/strain distribution through simulation method.

1.4 Scopes

The following studies are including in the study and analysis of the analysis of side door:-

i. Literature study on crashworthiness of side impact
ii. Tear off inside panel of the door
iii. 3-D scanning and inspection
iv. Conversion of 3-D model into simulation environment
v. Boundary condition setting
vi. Stress, strain and displacement simulation using Cosmos Works
vii. Analysis from result of stress, strain, and displacement
viii. Documentation

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Side impact accidents rank high in almost every country. Much research has focused on the development of countermeasures including the vehicle side structure energy absorption and human response in side impact events. New composite materials and structure optimization [4] have been widely used and some advanced methods have been developed to protect the occupants during side impact accidents. Tests and simulations similar to frontal impact safety tests are performed to evaluate a vehicle's side impact safety. [5]

Various side impact test methods exist and the moving deformable barrier (MDB) with pole side impact test are being used as the standard certified test on a car for side impact safety analysis. In China, the research focus is also switching from the frontal impact safety to side impact safety due to frequent occurrences of this type of accident. According to the Chinese road traffic accident statistics in 2002 [6] more than 33% of the accidents were side impacts. Furthermore, this led to high fatality rates for the small crash zone between occupants and vehicle structures. Starting in 2006, a side impact test, similar to the ECE R95, will be specified as the certified test for all new M1 class vehicles in China.

A typical midsized passenger car was selected to perform side impact simulations. According to the different characteristics of the impact modes, some suggestions are made for designing a safer car for side impacts.. In the year 2006, 445 died and about 4 000 were seriously injured at traffic accidents in Sweden (SRA). Those so many die and were seriously injured, depend to a great part of the shortcoming adaptation between the main components of the road transport system – man, vehicle and road. Those terrible figures render traffic to be one of the largest public health problems.

The most serious injuries occur at collisions against meeting or crossing vehicles and at single accidents against solid objects for example poles, trees and rocks on beside of the road. Even at legal speeds, such accidents can cause serious injuries or mortal outcome. Car safety can be divided in two respects, active safety known as driving safety and passive safety or crash safety. Active safety constitutes the qualities of the car, referring to avoid occurrence of an accident, (road holding, visibilities and brake system). Passive safety constitutes the qualities of the car, referring to protect the passengers at occurrence of a crash, (safety belts, airbags and head rests). The development is in progress for higher car safety in both respects.[7]

The European New Car Assessment Programme (Euro NCAP) is a European car safety performance assessment programme founded in 1997 by the Transport Research Laboratory for the UK Department for Transport. The organization is now backed by the European Commission, the governments of France, Germany, Sweden, The Netherlands and Spain, as well as motoring and consumer organizations in every EU country. Euro NCAP publishes safety reports on new cars, and awards 'star ratings' based on the performance of the vehicles in a variety of crash tests, including front, side and pole impacts, and impacts with pedestrians.[8]

2.1.1 Crash Test History

The roots of today's safety trend date back to the 1950s where such new car features as wrap-around windshields (elimination of distracting center dividers), padded dashboards and collapsible steering columns (shafts that collapse like a telescope in a collision). The crumple zone, safety steering column, steering wheel impact plate and side impact protection are examples of the pioneering inventions for which this first Mercedes safety engineer was responsible.

Automotive historians will remember the 1990's as the renaissance decade of automotive safety. During that decade occupant safety established itself as a leading marketing characteristic of motor vehicles. Vehicle crashworthiness as measured in standardized crash tests is currently ranked at equal level to quality, styling, ride and handling, and fuel economy

Safety features such as energy absorbing front and side structures, air bags, seats with integrated seat belts, and various crash avoidance devices are just some of the safety features offered as standard equipment on many vehicles. Future safety devices may include “smart” safety devices that would protect occupants based on age, gender, location in the vehicle, and crash severity. The focus on vehicle safety, meaning structural crashworthiness and reduction in occupant fatalities and harm, will undoubtedly continue to sharpen during the next decades in response to consumer demands, increasing government regulation and globalization of the industry.

i. **In the United States -** the National Highway Traffic Safety Administration (NHTSA) provides safety information through their New Car Assessment Program (US-NCAP), using crash-testing procedure of vehicles built after 1994. The Insurance Institute for Highway Safety (IIHS) does testing for the insurance industry, but data is only available for a few late-model vehicles.

ii. **In Europe -** the most popular models are crash-tested by the European NCAP, a consortium of governmental and auto clubs overseen by the FIA. Pedestrians and bicyclists are much more vulnerable than vehicle occupants when a crash occurs. The European NCAP's pedestrian evaluation tests the most hazardous areas of each model.

iii. **Germany's** Auto Motor und Sport magazine sponsors crash-tests of a small number of European cars but permits only subscribers to access the information.

iv. In Australia - the Australian NCAP (ANCAP) has recently adopted the Euro-NCAP testing procedures (they formerly used NHTSA test procedures).

v. **In Japan -** the National Organization for Automotive Safety & Victims' Aid (OSA) sponsors Japanese NCAP tests (full-frontal, frontal offset, and side impact) on the most popular Japanese home-market vehicles.[9]

2.1.1.2 Various Testing History

There is several testing from years o years to analyze crash test impact and severity to the occupants. Refer to **Table 2.1**; the 9 year of testing is done to implement the safety of a car.

Table 2.1 Testing made to improve the safety of a car.

1992	DaimlerChrysler Rear Entry (crash test and seat pull testing
1994	General Motors Transport Rear Entry (crash test and seat pull testing)
1994	DaimlerChrysler Side Entry (crash test and seat pull testing)
1995	Ford Windstar Rear and Side Entry (crash test, seat pull testing, brake test)
1996	DaimlerChrysler Rear Entry (crash test, seats, brakes, emissions, acoustic)
1999	Windstar Rear Entry (crash test, seat pull testing)
2001	DaimlerChrysler Rear Entry (crash test, fuel system integrity, seat pull testing)
2001	General Motors Venture Rear Entry (crash test, fuel system integrity, seat pull testing) [10]

2.1.2 Introduction To Proton Persona

Proton Persona also known as Proton Gen-2 Persona in United Kingdom and Indonesia is a national car that launch in year 2007. The Proton Persona is essentially a saloon based on the Gen-2 hatchback introduced in 2004. The most noticeable difference of the Persona from the Gen-2 is the separate, larger boot and less roofline slope.

This is a latest sedan family car with 1.6 liters (**Figure 2.1**) Campro four cylinder in-line engine which delivers a maximum output of 110bhp, 148Nm of torque and a top speed of 190km/h. From brochure stated in **Table 2.2**, it has 4477 mm length and 1725 width. Height from ground to top is 1438 mm. The horizontal distance from center of front wheel to the center of rear wheel is 2600 mm.

For high line, It comes with driver and passenger's dual airbags (**Figure 2.2**) with pretensioner seatbelt, antilock braking system, electronic brake distribution side impact protection bars, power assisted steering and reverse distance sensors all come as standard. The price is range between RM44,999 to RM55,800 is a competitive price and affordable for Malaysian citizen. With all the accessories and better finishing from previous model, Proton Persona demand continues to outstrip supply.

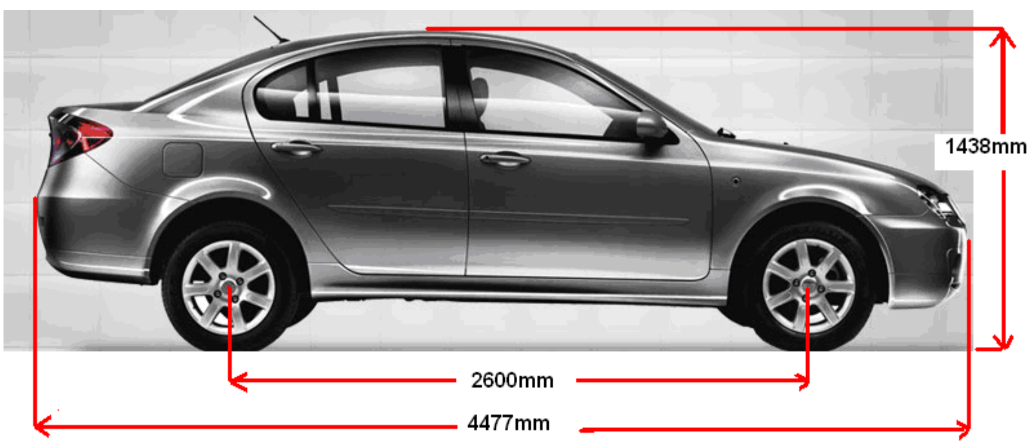


Figure 2.1 Proton Persona side view

Figure 2.2 Dual air bags for high line model

2.1.3 Door Components

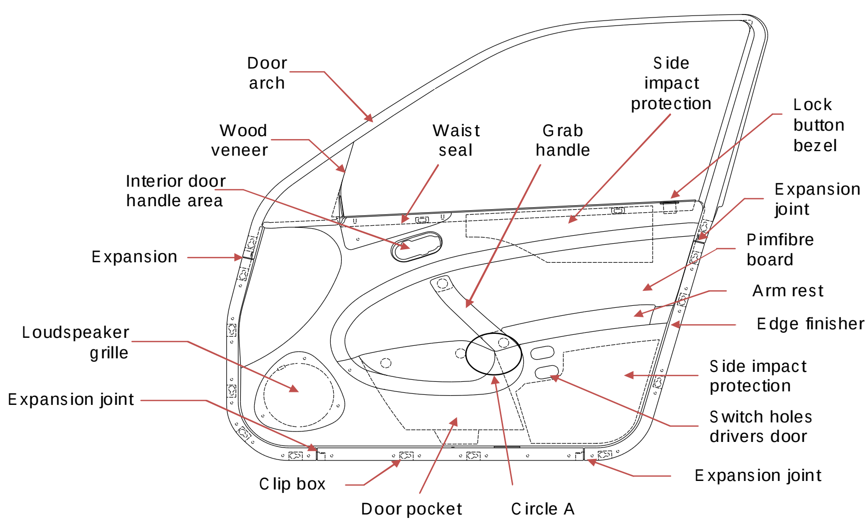


Figure 2.3: Front door trim assembly (Zamri Mohamed.2008)

The door is generally comprised of the outer (**Figure 2.5**) and inner panels. (**Figure 2.4**) usually made of sheet metal and the interior trim pane such as arm rest, grab handle and door pocket as seen on **Figure 2.3**. .The door frame is designed to resist collision forces and also serves to transmit crash loads from the region around the occupant to other vehicle structures during the mash. The outer panel (skin) is struck by the impactor (MDB) and moves together with the MDB almost immediately after contact. The impactor, after crushing the door panel, pickup the door sill, floor pan, rocker panel and B-pillar.

Thereafter, the door moves together with the rest of the vehicle structural components at a common velocity.

Figure 2.4: Original state door components

Door has to be clean and remove from dirt, dust and unfixed components such as wiring system and plastic cover.

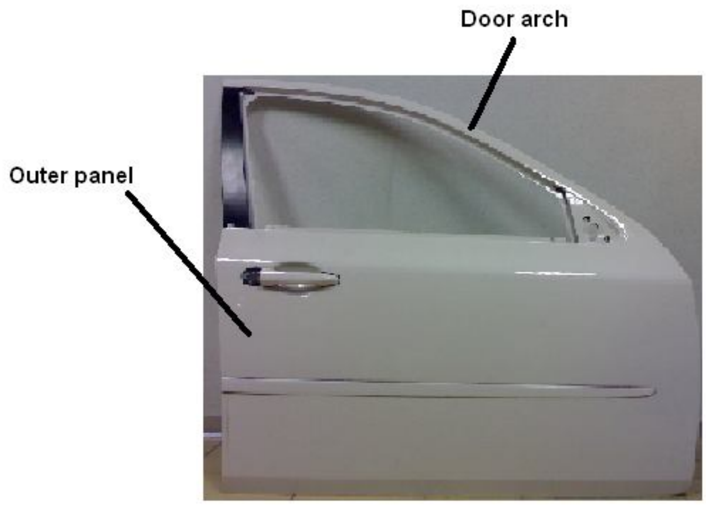


Figure 2.5: Proton Persona outer panel door

The outer panel after the cleaning process is ready for scanning process and solid modeling.

2.14 Type of Test

Crash testing of vehicles is a way to determine if best practice in terms of occupant protection for a new car. Euro NCAP is a crash test program, which was set up in 1996. Since that, 64 different car models have been tested and the results have been published. The cars are tested in a frontal collision and in a side collision. The possibility of adding a pole test has been introduced 2000.

Crash tests are conducted under rigorous scientific and safety standards. Each crash test is very expensive so the maximum amount of data must be extracted from each test. Usually, this requires the use of accelerometer with high-speed data-acquisition as shown in **Figure 2.6** and **Figure 2.7**, at least one triaxial accelerometer and a crash test dummy, but often includes more to calculate and record the deformation results. [8]

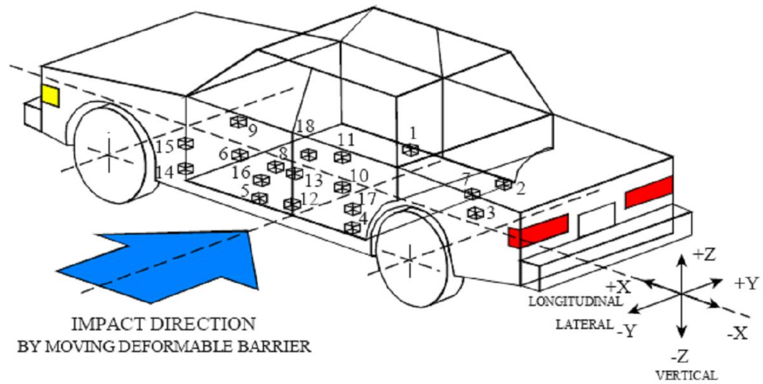


Figure 2.6: Location of accelerometer [9]

Location of accelerometer in a real world testing to measure the stress, strain and displacement of the structure.

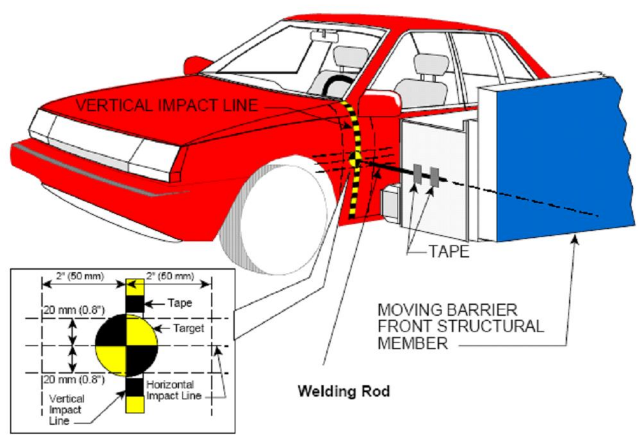


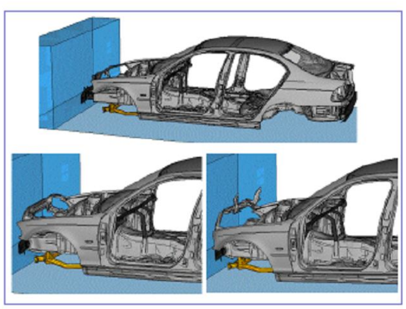
Figure 2.7: Point of impact [9]

Contact surface of barrier and struck car with its vertical line which illustrated in simulation mode.

Impact can be divided into several types. Namely, frontal impact, offsets impact, side impact, pole impact and roll over. Test for each of the impact criteria are:

i. Frontal impact
ii. Offset impact
iii. Roll over impact
iv. Pole impact
v. Side impact

Table 2.2: Categories of Impact Testing

1. Frontal-Impact  	These are usually impacts upon a solid concrete wall or barrier at a specified speed, but can also be vehicle-vehicle tests. The car is driven towards the barrier by a wire system. At 64 kph (40 mph) the car hits the deformable barrier with 40% of the width of the car. Both the driver and the passenger are belted in the front seat and the seats are adjusted to middle position. The crash test dummies (Hybrid III) used has the same height and weight as an average man [10]

2. Offset Tests 	Only part of the front of the car impacts with a barrier (vehicle). These are important, as impact forces) remain the same as with a frontal impact test, but a smaller fraction of the car is required to absorb all of the force. These tests are often realized by cars turning into oncoming traffic. In the U.S., this type of testing is done by the IIHS and EuroNCAP[10]
3. Roll-over 	A car's ability (specifically the pillars holding the roof) to support itself in a dynamic impact. More recently dynamic rollover tests have been proposed as opposed to static crush testing. [10]
4. Pole Impact 	The car is propelled sideways at 29 km/h (18 mph) into a rigid pole with a 254 mm diameter. The pole's target area is the drivers head. The driver is belted in the front seat and the seat is adjusted to middle position. The crash test dummy (EuroSID-1) used has the same height and weight as an average man. [10]

5. Side-Impact  	Very significant likelihood of fatality, as cars don't have a significant crumple zone to absorb the impact forces before an occupant is injured. In a side crash test a trolley (width 150 cm and weight 950 kg) with a deformable front is towed into the driver’s side of the car at 50 kph (30 mph). very significant likelihood of fatality, as cars don't have a significant crumple zone to absorb the impact forces before an occupant is injured. In a side crash test a trolley (width 150 cm and weight 950 kg) with a deformable front is towed into the driver’s side of the car at 50 km/h (30 mph). [10]

2.2 SIDE IMPACT IDEOLOGY

A side impact defined as a collision in which the front or rear end of the striking vehicle contacts the struck vehicle in area of one or more of the vehicle structural pillars. An analysis of injury severity in the context of collision configuration expressed as a directional priority indicates the disproportionate occurrence of significant injuries in side impact collision.

Since 1997, the NHTSA has carried out forty-six full scale side impact tests under NCAP. Accelerometers were installed in various locations of the test vehicle including the door panels, A- and B-pillars, sills and floor, and vehicle center of gravity (CG). This information, combined with data recorded from occupants, is used in this study to investigate the differences in safety performance and identify design parameters that influence vehicle side crash protection. [11]

Based on the most harmful event, side impact accounts or 25 % of fatalities for passenger car and light truck crashes in the USA. For passenger cars, side impact accounts for approximately 30 percent of the fatalities in passenger car crashes[12] In comparison with frontal collisions, the space between the occupants and the intruding element in side crashes is extremely small. In addition, the side impact crash occurs much more rapidly. Consequently, occupant protection in side crashes presents a challenge to engineers designing a vehicle for safety. Side impact analysis indicates that side impact bar play an important role to reduce the risk of serious and fatal injury by minimizing and provide lateral stiffness of the side structure and get more human live space [13]

The door, mainly discretized is by the shell elements. During the analysis the door undergoes severe deformation normally leading to a failure of the modeled side window.

In car accidents, side impacts result in numerous injuries because the side structure of the car, including the occupant compartment, is crushed. During design, the strength of the door should be stressed for passenger safety. It is belief that improvements in the strength, numbers, and the configuration of the bar impact at door itself (refer to **Figure 2.8** and **Figure 2.9**) is quite effective for passenger safety, particularly in collisions from the oblique direction, or with fixed objects. That the reason of most racing car for example rally car have roll cage and cross type impact bars as seen in **Figure 2.10.**

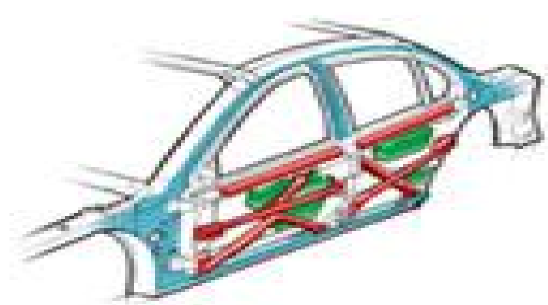


Figure 2.8: Side Bars Configuration

Figure 2.9: Door Reinforcement (side bar) and Padding

Figure 2.10: Racing Cross Type Side Bar

During a car-to-car side collision, the physical event is a complicated transfer of momentum from the striking car to the struck car. To a large extent he severity of the crash event, as seen by the occupant in the struck vehicle, is determined by the time rate of change for this momentum transfer. The time rate of momentum transfer, in turn, is dependent upon the relative structural stiffness and effective mass distribution, among other factors, of the individually struck cars. Because of their proximity to the impacting car and the occupant, the doors (front and rear) and the pillars (essentially the A- and B-pillars) of the struck vehicle are among the components that play a critical role in deciding how the momentum transfer is being carried out around the occupant.

The doors and the pillars use their energy absorbing capability and their material strength to channel the momentum transfer. In addition, the intruding door structure can provide an interior surface that crashes at a non-injurious level and acts to protect the occupant. The characteristics of the dynamic interaction between these components and the vehicle occupants (the SID test dummies) determine the effectiveness of the vehicle side crash protection performance.[14]

2.2 CURRENT U.S SIDE IMPACT STANDARD

On October 30, 1970, the Federal Motor Vehicle Safety Standards (FMVSS) were modified by the addition of Standard 214; Side Impact Strength - Passenger Cars. The standard went into effect on January 1, 1973[12]

The purpose of the standard was to enhance side door strength to minimize the safety hazards caused by intrusion into the passenger compartment during a side impact. The test procedure required "quasi-static" loading applied by a rigid steel cylinder or semi cylinder. Intermediate and peak crush force limits were established. This "quasi-static" requirement was extended to trucks, buses, and multipurpose passenger vehicles with a gross vehicle weight rating (GVWR) below 4,535 kg (10,000 lbs), effective September 1, 1993 [13]. The agency's 1982 evaluation of this

"quasi-static" requirement indicated that the standard was effective in side impacts of single vehicles into fixed objects but provided little benefit for occupants in vehicle-to-vehicle collisions.

On October 30, 1990, a final rule was published adding a dynamic impact requirement for passenger cars to FMVSS 214; to address fatalities and injuries in vehicle-to-vehicle collisions. The requirement was phased-in such that all passenger cars made after September 1, 1996, had to comply. Subsequent to this action, a final rule was published requiring trucks, buses, and multipurpose passenger vehicles under 2,721 kg (6000 lbs) to meet the dynamic impact requirement by September 1, 1998 [15]

This is achieved by a moving deformable barrier (MDB), with all wheels rotated 27 degrees (crab angle) from the longitudinal axis, impacting a stationary test vehicle with a 54 km/h closing speed. For a typical passenger car, the left edge of the

MDB is 940 mm forward of the mid point of the struck vehicle wheel base. The MDB has a total mass of 1367 kg. The aluminum honeycomb of the barrier face is specified by design and its element.

The dimensions and material characteristics of the MDB face are shown in.**Figure 2.11** and **Figure 2.12**. This was initially derived from the weights of passenger cars and lights trucks in the U.S. fleet with a adjustment made assuming a downward trend in vehicle mass due to fuel economy needs [16]

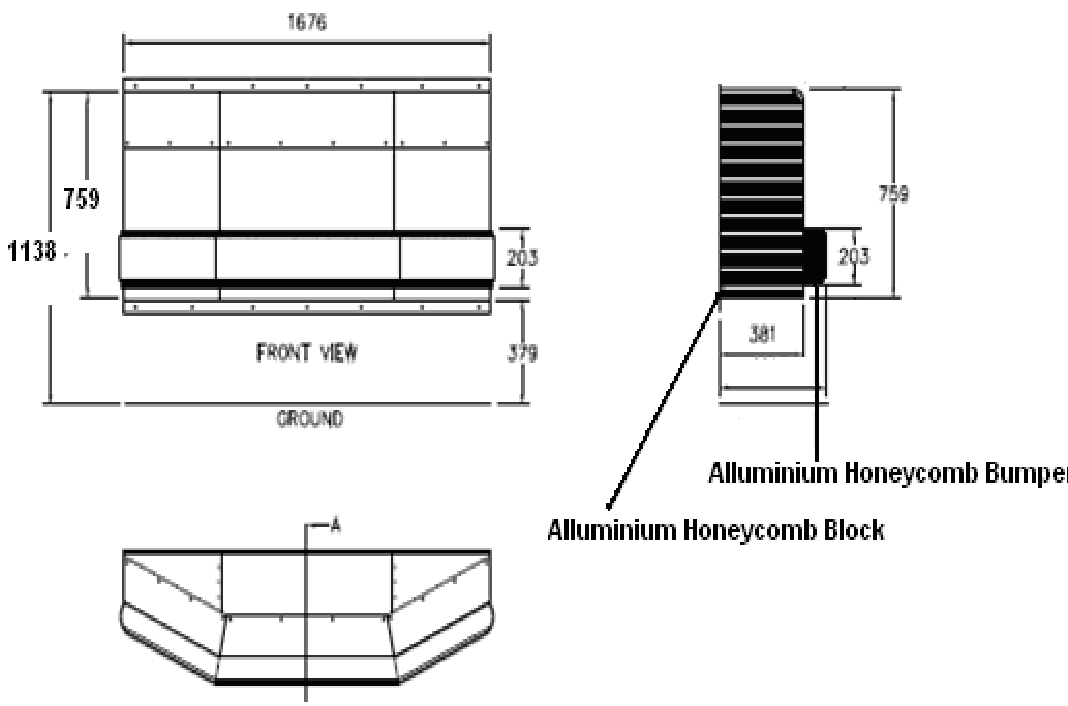


Figure 2.11 - FMVSS 214 Side Impact Deformable Barrier Element [17]

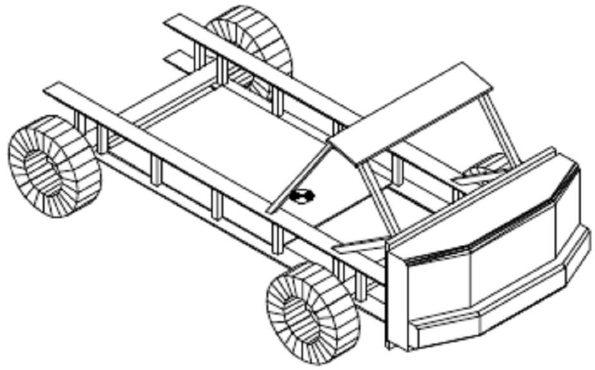


Figure 2.12 - FMVSS 214 Side Impact Deformable Barrier Face[17]

Side Impact Dummies (SID) are placed in front and rear occupant positions on the side of the vehicle which is being struck. The instrumented dummies must exhibit rib, spine and pelvic accelerations below specified thresholds in order to pass the test.

2.31 Crash Test Procedure

The vehicle impact tests that generated the data used in this analysis were conducted in accordance with the test procedure of the side impact NCAF'. The NCAP side impact test is based on the dynamic requirements of FMVSS No. 214, but is conducted at a higher speed. The NCAP tests, which simulate an intersection collision, were conducted with a moving deformable barrier (MDB), as the striking vehicle. The 1360 kg MDB was moving at a speed of 61 km/h and at an angle of 90 degrees off the perpendicular to impact a stationery vehicle,

Twenty or so accelerometers were installed at various locations of the test vehicle to monitor the motion of the test vehicle and its structural components. Since the vehicle side doors and the doorframes play an important role in side impact protection, special instrumentation used to capture the dynamic responses of these components. For the front door, three accelerometers were installed on the interior surface of the inner door panel. For the B-pillar, two accelerometers were mounted on the interior surface of the inner door panel.

The outer panel (skin) is struck by the impactor (MDB) and moves together with the MDB almost immediately after contact. Within 3 to 5 milliseconds, velocity of the inner panel (together with the interior trim panel) rises to the speed of the striking vehicle as it (the door) continuously undergoes deformation.

2.4 CORRELATION WITH REAL WORLD CRASHES

There is a need to relate crash test characteristics and outcomes with those of real world crashes. In this way better informed decisions can be made about the future direction of NCAP programs. Key issues that need to be addressed are types of tests to be conducted, test speeds and configurations, number and type of dummies, types of injuries to be assessed and, for the rating system, the relative weight given to various injuries and types of tests.

Several comparisons have been made between crash test results and injury outcomes in real world crashes. Hackney et al (1996) report on an analysis the impact speeds in real world crashes and a comparison of injury outcomes with those predicted from NCAP tests in the USA.

Newstead et al (1996) describe an assessment of the correlation between ANCAP results and real world crash data. This included an analysis of injury data from insurance records.

Whilst these comparisons are a good start they do not allow assessment of the predictive for specific injuries, such as say the head, chestor lower legs, for the different makes and models. Comparisons of this kind will require in-depth studies with good quality injury data.[18]

CHAPTER 3

METHODOLOGY

3.1 Project Methodology

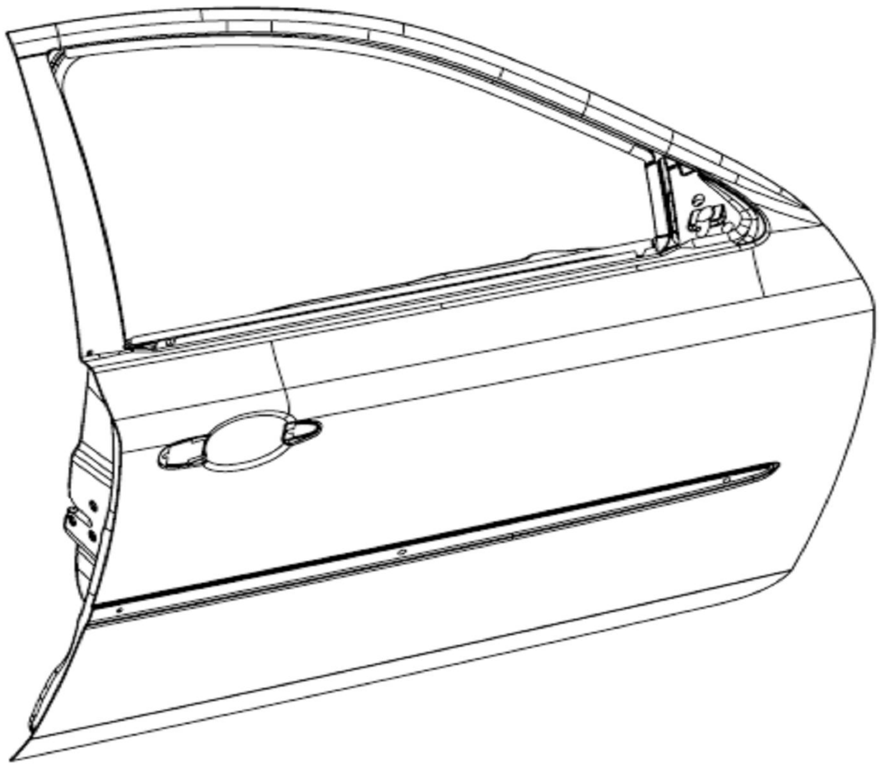
In fulfillment of the project objective, there are two major important step in getting 3D model and simulation analysis. These including

i. Step 1: 3D Scanning and Solid Modeling
ii. Step 2: CAE Simulation

All of this stage should be followed to ensure that simulation analysis will perform successfully and without any error would occur. Solid modeling of door is get by using 3 Dimension Scanner. There is several steps and method to be done accordingly .First of all after removal of driver's side door; the cleaning process is done together with setup of 3 dimension scanner environment. Then, setup the scanner material before conversion of the model by using Polyworks software.

Second steps including of CAE Simulation.Model was imported into Cosmos works to setting the fix the force amount, restraint location, and meshing the model. Then run the simulation to get the result in html form or in motion scene. The stress, strain and displacement result is then documented.

Figure 3.1 shows the flow chart resemble the divisions of works and study have been made in all the way of achieve the objective of the project.



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS	DEBUR AND BREAK SHARP EDGES	WEIGHT:	TITLE: Isometric View of Proton Persona Door (Driver)	MATERIAL: AISI 304	DWG NO.	QTY:	SHEET 1 OF 1	SCALE 1:2	
FINISH:	DO NOT SCALE DRAWING	SURFACE FINISH: TOLERANCE: (UNLESS SPECIFIED) LINEAR: ±0.1MM ANGULAR: ±0.1MM		REVISION:	UNIVERSITI MALAYSIA PAHANG Fakulti Kejuruteraan Mekanikal				A4

	NAME	SIGNATURE	DATE
DRAWN	RAJA ASHRAFUZZAIM ZOLKIPLY		
APPV'D	GAN LEONG MING		